Vol. 95 (2001) 337–342

Spontaneous pneumothorax : pragmatic management and long-term outcome

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Abstract We prospectively considered 65 patients admitted for a spontaneous pneumothorax (SP) to describe the pragmatic management of SP, the first recurrence-free interval after medical therapeutic procedure and to specify the first recurrence risk factors over a 7-year period in these patients treated medically.

The treatment options were observation alone (9%), needle aspiration (6%), small calibre chest tube (Pleurocatheter®) drainage (28%) or thoracic tube drainage (49%), and pleurodesis with video-assisted thoracic surgery procedure (8%). Duration of the drainage and length of hospital stay were shorter in the Pleurocatheter® group than in the thoracic tube group ($P < 0{\cdot}01$). Among the 47 patients (72%) with a first SP and treated medically, nine patients (19%) had a first homolateral recurrence (FHR) during a mean follow-up of 84 ± 13 months. Recurrence-free intervals ranged from 1 to 24 months (mean $\pm$ SD: $9{\cdot}3 \pm 8{\cdot}4$ months). FHR cases were more frequent in the Pleurocatheter® group ($P < 0{\cdot}04$).

Analysis of potential risk factors showed that the patient's height and a previous homolateral SP episode are independent recurrence risk factors.

doi:10.1053/rmed.2000.1028, available online at http://www.idealibrary.com on IDEAL®

Keywords spontaneous pneumothorax; management; recurrence.

INTRODUCTION

Spontaneous pneumothorax (SP) is defined as the presence of air in the pleural cavity, irrespective of any traumatic or iatrogenic context. It is said to be idiopathic or primary in the absence of any disease detectable through a clinical and/or radiological examination. In most cases it is a benign disease although it may become worrying due to frequent, unpredictable recurrences —30–35% according to the series and method of treatment (1). Procedures for the initial treatment of SP may vary—observation, needle aspiration, small or large calibre chest tube drainage, or pleurodesis with video-assisted thoracic surgery procedure. The choice of method is controversial, depending on criteria associated with the pneumothorax such as degree of detachment and presence or absence of symptoms, and on the practitioner's experience of each technique. In fact, other factors such as recurrence risk might also define the initial therapy (2). In 1993, guidelines for SP management were published. They proposed a therapeutic strategy based on the presence or absence of a suspected underlying respiratory disease and the degree of SP (3). Several previous surveys have shown a recurrence risk of SP, principally in connection with the presence of an underlying respiratory disease (2,4,5). However, few studies have dealt with the specific risk of recurrence (6). Initiated before the guidelines were published, our survey aims to describe the pragmatic management of SP in a French Department of Respiratory Disease, the first recurrence-free interval after medical therapeutic procedure and to specify the first recurrence risk factors over a 7-year period in this patients treated medically.

Received 10 February 2000 and accepted in revised form 23 July 2000
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MATERIAL AND METHODS

In our Respiratory Disease Department, we screened 78 consecutive patients hospitalized for the first time for a SP between 1 January 1988 and 31 September 1991. They ranged from 17 to 88 years of age. Among the 78 patients considered, 13 were lost to follow-up despite general practitioner (GP) contact and patient phone number research. Therefore, the files of 65 patients were analysed. For each patient, data included: height, weight and body surface; family or personal history of the SP; side of SP;

size of the radiological detachment on chest X-ray: partial SP (detachment of the apical lung surface inferior to 3 cm in the mid-clavicular line) or complete SP (detachment of the apical lung surface superior to 3 cm in the mid-clavicular line); revealing symptoms; interval before treatment started; therapeutic procedure used; date of recurrence.

The therapeutic protocol was pragmatically chosen by the chest physician primarily responsible for the patient: observation alone; needle aspiration; small chest tube drainage 8 F, length: 50 cm (Pleurocatheter®, Laboratoire Plastimed, Saint-Leu-La-Forêt, France); thoracic tube drainage (PVC) Ch. 14 to Ch. 24, length: 30 cm (Laboratoire Vygon, Ecouen, France); surgical pleurodesis.

Once the drainage was chosen, the chest tube was inserted after local anaesthesia and intercostal muscle dissection either in a frontal position (second intercostal space in the midclavicular line) with the patient in dorsal decubitus, or in an axillary position (fifth or sixth intercostal space in the mid-axillary line) if the patient could withstand being in lateral decubitus on the side opposed to the SP. Then, the chest tube was attached to a Heimlich flutter valve and connected to the vacuum source via a two-bottle regulated system adjusted to create a depression of 20–50 cm H_2O. After 24 h without bubbling in the water seal bottle and a complete radiological reexpansion of the lung, continuous aspiration was stopped. The chest tube was left in place for 24 h with the Heimlich valve at atmospheric pressure. Finally, if a clinical and radiographical examination failed to reveal a detachment, the chest tube was removed. The patient left the department once a final radiological control showed no detachment. The treatment was considered a failure when the bubbling continued after 10 days of drainage (lengthy air leak). The medical therapeutic procedure (i.e. observation, needle aspiration, small chest tube drainage, thoracic tube drainage) adopted for the survey was that allowing the resolution of the SP—considered as a success—during the initial hospitalization.

Once a surgical pleurodesis was chosen, transfer to the Thoracic Surgery Department was decided by the chest physician primarily responsible for the patient in case of a personal controlateral SP history, a personal previous recurrence (i.e. two previous SP episodes), or by one of the authors (J.M.V., P.C., P.V., A.T.) after failure of the drainage (more than 10 days with bubbling). When surgical pleurodesis was performed, the patient was excluded from the survey. One month after the SP in the group of patients successfully treated with a medical procedure, we assessed blood α_1 anti-trypsin, a chest X-ray, spirometry with whole body plethysmography (Jaeger MasterLab-IsoFlow, Wuerzburg, Germany) and a diffusing capacity test (DL_{CO}) and a computed tomography (CT) scan of lung to calculate the Warner bleb score (7).

The Warner bleb score was evaluated independently from data collection by two physicians, a radiologist (F.L.) and a chest physcian (M.T.L.) who had not taken part in any other way.

Recurrence was defined by the homolateral recurrence of the SP. The rate of first recurrence was calculated by observing the patients included in the survey at the time of the first SP episode treated medically. The investigation regarding the recurrence was conducted in March 1997, average delay 84 ± 13 months. To take into account a recurrence occurring or treated in another hospital, information was collected by a simple postal questionnaire from the GP or by phone when the questionnaire was not returned. The patient was directly contacted when the GP had lost contact.

The statistical analysis was carried out in several stages: (a) descriptive univariate analysis, the means being given with their standard deviation (mean $\pm$ SD); the chi-squared test to analyse contingency tables; the student's t-test to compare the quantitative variables. A difference was considered as statistically significant when $P < 0{\cdot}05$· (b) Bivariate analysis using recurrence as a dependent variable, the other variables being clinically significant as independent variables according to the literature; and (c) analysis through logistic step-by-step regression according to the Hosner and Lemeshow method, with a conservative threshold at $P < 0{\cdot}25$.

RESULTS

Population

Among the 65 subjects analysed, there were 49 men and 16 women aged 30 ± 12 years on average at the time of the initial SP. The average body surface was $1{\cdot}173 \pm 0{\cdot}12\ m^2$ for men and $1{\cdot}58 \pm 0.13\ m^2$ for women ($t = 4{\cdot}2$, $P < 0{\cdot}0001$). Five patients (8%) had a previous SP history among their sisters and brothers and 21 patients (32%) had a personal SP history, 18 of them on the same side. Fifty-two patients (80%) were smokers. Thirty-two SPs were on the right side, 33 on the left. Forty-six patients (71%) had a complete SP and 19 patients (29%) had a partial SP.

Pain was the most usual revealing symptom (85%); it was always sudden and appeared without any triggering factor. Dyspnoea was also present in 25% of the cases and cough in 3%. In the group of patients treated with drainage, the interval between the first symptoms and the time of drainage was 45 ± 54 h.

Table 1 shows the distribution of therapeutic protocols. Two-thirds of the patients were treated with a drainage (thoracic tube drainage or Pleurocatheter®). There was no significant difference in the patients' age or in the size of the detachment whatever therapeutic protocol was proposed (data not shown).

Ten lengthy bubblings were observed, three of which required surgical pleurodesis. Drainage complications appeared in six of the 60 non-surgical patients (10%):

three haemothorax; two considered as minor (one with thoracic tube drainage and one with Pleurocatheter®) without any specific treatment and one with Pleurocatheter® considered as serious because of requiring a surgical haemostasis, one clotted Pleurocatheter®, one skin infection around the incision of a thoracic tube drainage and one thoracic tube drainage excluded.

Table 2 shows the duration of drainage according to the size of detachment and the type of drainage used. Duration of the drainage and the length of hospital stay were shorter in the Pleurocatheter® group than in the thoracic tube group ($P < 0{\cdot}01$); on the other hand, the length of hospitalization following the moment the drain was removed was shorter when a Pleurocatheter® was used compared with thoracic tube drainage, but not significantly ($1{\cdot}7 \pm 1{\cdot}3$ days *vs*. $2{\cdot}6 \pm 3$ days, $t = 1{\cdot}4$, $P = 0{\cdot}18$).

Fifty-three patients (81%) had a CT scan 1 month after the SP episode. It was normal in 20 of them. As there was no systematic millimetric section, the Warner bleb score could only be calculated for 25 CT scans (47%). The score was zero in all the patients with a partial SP ($n = 5$); the mean value of the Warner bleb score in the group of patients with a complete SP ($n = 20$) was $22{\cdot}8 \pm 28{\cdot}6$ on both sides and $17{\cdot}1 \pm 19{\cdot}8$ when considering the SP side alone.

Forty-five patients (67%) performed a spirometry 1 month after the SP episode. The mean values of the main parameters [forced expiratory volume in 1 sec, (FEV_1), vital capacity (VC), residual volume (RV)] were normal ($99 \pm 19\%$, $100 \pm 17\%$, and $109 \pm 33\%$, respectively). Seventeen patients (26%) had a DL_{CO} test. The mean value was normal ($81 \pm 22\%$).

Table 1. Therapeutic protocols used

Therapeutic protocols	Patients *n*(%)
Observation	6(9)
Needle aspiration	4(6)
Pleurocatheter®	18(28)
Thoracic tube drainage	32(49)
Surgical pleurodesis	5(8)

Recurrence survey

Among the 65 patients in our survey, 47 were included at the time of the first SP episode and had no surgical management. Among these 47, nine had a first homolateral recurrence (FHR) during the follow-up period, i.e. a 19% FHR rate. This group of patients consisted of eight men and one woman, aged $27{\cdot}4 \pm 7{\cdot}3$ years. Their average body surface was $1{\cdot}67 \pm 0{\cdot}1\ m^2$ and that of the group of patients who had suffered no recurrence was $1{\cdot}69 \pm 0{\cdot}15\ m^2$ (NS). Seven patients (78%) had a complete SP. There was no difference between the smoking habits of the patients who had FHR and those with no recurrence ($12{\cdot}2 \pm 9{\cdot}8$ *vs*. $8 \pm 7{\cdot}3$ pack-years, respectively). Two non-smokers were in the group with FHR and four in the recurrence-free group (NS). The recurrence-free intervals ranged from 1 to 24 months (mean: $9{\cdot}3 \pm 8{\cdot}4$ months).

The treatment procedures for the initial episode of SP in the nine above-mentioned patients and the recurrence rate are shown in Table 3. The number of patients with FHR was significantly higher in the Pleurocatheter® group ($P < 0{\cdot}04$). Fifty per cent of the Pleurocatheter® drainage complications treated irrespective if lengthy air leak occurred in patients who had a first recurrence. However, the mean drainage duration and the mean length of hospital stay showed no significant difference between the patients with FHR and the recurrence-free patients: $4{\cdot}7 \pm 2{\cdot}3$ *vs*. $5{\cdot}6 \pm 2{\cdot}4$ days and $6{\cdot}8 \pm 2{\cdot}8$ *vs*. $7{\cdot}8 \pm 3{\cdot}7$ days, respectively. There was no statistical difference either in serum α_1 anti-trypsin ($2{\cdot}6 \pm 0{\cdot}5$ *vs*. $2{\cdot}7 \pm 0{\cdot}5\ mg\ ml^{-1}$), Warner bleb score on the CT scan whether calculated on both sides ($8{\cdot}6 \pm 1{\cdot}4$ *vs*. $23{\cdot}3 \pm 30{\cdot}6$) or on the SP side ($3{\cdot}7 \pm 5{\cdot}3$ *vs*. $12{\cdot}6 \pm 19{\cdot}7$). Two of the patients (3%) presented a contralateral SP episode during the follow-up period.

Analysis of missing data

The limited number of cases available for the Warner bleb score ($n = 25$) made it impossible to keep this variable in the rest of the statistical survey. The variable 'size of the detachment' was not considered either as its degree of significance was below the conservative threshold assigned (odds ratio = 0·91, 95% confidence interval 0·26–2·15, $P = 0{\cdot}86$).

Table 2. Duration of drainage and length of hospital stay

	Complete SP	Partial SP	*P*	Thoracic tube drainage	Pleuro catheter®	*P'*
Duration drainage (days)	$5{\cdot}5 \pm 2$	$6{\cdot}5 \pm 3$	NS	$6{\cdot}3 \pm 2{\cdot}4$	$4{\cdot}6 \pm 2$	0·01
Length of stay (days)	$7{\cdot}7 \pm 3{\cdot}9$	$7{\cdot}5 \pm 4.1$	NS	$8{\cdot}8 \pm 3{\cdot}7$	$6{\cdot}2 \pm 2{\cdot}5$	0·01

P: comparison between complete SP and partial SP.
P': comparison between thoracic tube drainage group and Pleurocatheter® group.

Table 3 Recurrence rate according to therapeutic protocol used

Therapeutic protocols	Recurrences (n=9)	Rate (%)
Observation (n=6)	1	17
Needle aspiration (n=4)	0	0
Pleurocatheter® (n=18)	6	33*
Thoracic tube drainage (n=32)	2	6

$P < 0.04$ between Pleurocatheter® group and thoracic tube drainage group.

Table 4 Statistical modelling

	Regression coefficient	P	Odds ratio
Intercept	0·9	0·21	
Sex	−0·52	0·41	0·59
Height	0·99	0·23	1·001
Personal homolateral past history of SP	0·99	0·14	2·7
DL_{CO} value	0·16	0·81	1·002

SP: spontaneous pneumothorax.

Multivariate analysis by logistic step-by-step regression

The initial logistic regression model included nine variables: sex, age, weight, height, smoking habits, personal history of pneumothorax, time between first symptoms and drainage, type of drainage and DL_{CO} value. The unavoidable variables chosen according to the literature were sex, height and DL_{CO} value. Some variables were turned into dichotomic variables to allow modelling (sex, smoking habits, personal SP history). Age, height, weight, time between the first symptoms and drainage, and DL_{CO} value were kept as quantitative values; the type of drainage was left as a four-grade qualitative variable. Interactions were not tested as none seemed clinically relevant. The final modelling of the logistic regression (Table 4) showed that sex was not a risk factor for SP recurrence, unlike height and a previous homolateral history. After adjustment on the other factors, DL_{CO} value was not a recurrence risk factor, unlike in bivariate analysis where it was on average lower in the group of patients with FHR than in the FHR-free group: 72% *vs.* 86%, $P = 0·2$, respectively.

DISCUSSION

This study presents the results of a pragmatic therapeutic management of SPs in a respiratory unit. It shows that: (a) the rate of long term success is 81%, from 67% to 100% according to the therapeutic protocol adopted; (b) the average length of hospital stay for the patients treated by Pleurocatheter® is significantly shorter than for those treated by thoracic tube drainage; (c) the recurrence rate is low, but seems higher in the group treated by Pleurocatheter®; (d) most of the time, recurrences occur within the 2 years following the initial episode despite a long-term follow-up; (e) the Warner bleb score does not seem useful in the assessment of recurrence risk; (f) size of detachment is not a predictive factor for recurrence; (g) height of patient and a previous SP history are risk factors in multivariate analysis.

The characteristics of our population do not differ from those mentioned in the literature: most SPs occur in patients under 50 years, and an obvious male predominance is also found (1,2,8). The choice of the treatment was not randomized in our study, which may bias the comparative analysis of the efficacy of each procedure, especially for both drainage systems. However, initial randomization is not easy on account of the low incidence of this pathology (1,5). In the absence of any guidelines (3) at that time to management, it was possible to guide the therapeutic procedure by using various factors such as the patient's dyspnoea level, the extent of SP or the practitioner's experience of each technique. However, SP treatment seems to have been effective since there was no recurrence in 81% of the cases, this rate being similar to that mentioned in several other surveys (2,4,8). The rate of immediate success according to the therapy was 100% for aspiration and surgery, 94% for thoracic tube drainage, 83% for observation alone and

67% for Pleurocatheter®. In the literature, the usual success rates are 70–90% for thoracic tube drainage (8–10) and 87–95% for Pleurocatheter®, given that the reported studies do not always concern SPs alone (11–13). The success rate of observation alone ranges from 24% (8) to 100% (2), again for pneumothorax with an extent below 15%. Only O'Rourke (8) underlines the potentially dangerous aspect of this strategy: two deaths in a series of 168 patients due to compressive pneumothorax occurring in the group of patients with observation alone. As mentioned in various publications, the needle aspiration rate ranges from 71% to 100%. Combined with a shorter length of hospital stay and the absence of complication, such efficacy has induced many authors (8–10,14) to recommend this as first-line therapy, which is the British Thoracic Society's opinion (3). On the other hand, Boutin (15) prefers an interventional attitude from the very first episode, i.e. a thoracoscopy allowing a lung lesional assessment and the treatment of the causal blebs (electro-coagulation or endo-GIA forceps resection) followed by a pleurodesis with talc powder or pleural abrasion to prevent recurrences. He explains this attitude by the same duration of drainage (4 ± 1 days), the absence of long term complications, that provided strict rules of talc volume are respected (2 ml), and the low recurrence rate (below 5%) after this type of pleurodesis. As our study shows that a previous SP history is an independent factor for recurrence risk, a pleurodesis could be proposed when the second episode occurs, and not the third. There were very few complications of lengthy drainage apart from lengthy air-leak (9·8%) and these occurred only with the two drainage systems, being apparently as frequent with thoracic tube drainage as with the Pleurocatheter®. We choose a shorter persistent air-leak delay than others authors; this choice could probably underestimate the real success of our procedures (16). There were only two haemorrhagic complications with the Pleurocatheter® and only one with thoracic tube drainage. This is contrary to what has been said about the Pleurocatheter® and its supposed untraumatic, less uncomfortable and painful nature for the patient than standard thoracic tube drainage (11–13). haemorrhagic complications with the Pleurocatheter® could be due to the insertion of the bevelled trocar which is not always preceded by an intercostal muscle dissection with forceps, similar to that made before setting up a thoracic tube drainage: introducing the Pleurocatheter® must be done very cautiously after checking the haemostasis and carefully locating the path level with the top edge of the lower rib. We have noticed that the average length of hospital stay for patients treated with the Pleurocatheter® is shorter than those treated by thoracic tube drainage. The difference seems related with a significantly shorter drainage duration when using the Pleurocatheter®, a difference Martin has already mentioned (12). Thus, using a Pleurocatheter® could be less costly, but only a medical audit would ascertain this by taking into account, for each type of therapy, the cost of the equipment, the medical and nursing times necessary for management, the length of hospital stay and the cost of the complications and recurrences, even though, according to our survey, these are significantly more frequent with the Pleurocatheter®.

Our average follow-up time is 7 years, whereas it has rarely exceeded 6 years in other surveys (2,5,8). In our work, the global recurrence rate is 19%, i.e. among the lowest rates in the literature whereas rates between 10–60% have been reported (2,4,5,8–10,12,13). In spite of this average lengthy follow-up, no first SP recurrence has occurred beyond the end of the second year (average occurrence interval: $9{\cdot}3. \pm 8{\cdot}4$ months). Even if few surveys have assessed this interval in a homogeneous population of patients with a first SP episode, most show identical findings (5,14).

Patient's height is a SP recurrence risk factor highlighted in our survey. Lippert (4) had already shown the part played by the height of tall, thin patients in a survey of 144 subjects, 122 of whom had a SP previous episode. The pathogenesis of this is unknown. We also studied an already published bleb score (7) but were unable to highlight any significant difference between patients with a recurrence-free SP and those with a first recurrence. Indeed, the average bleb score was higher in the recurrence-free group than in the first recurrence group. This could be due to the restrictive character of our survey which includes only patients with a previous SP recurrence, whereas Warner (7) included a high proportion of patients with several SP recurrences treated by chemical pleurodesis (four patients) or by surgery (four patients). Resorting to such therapeutic options was probably induced by pulmonary lesions which were greater than those in patients with a previous recurrence. Some authors have also stressed the importance of morphologic CT scan of the apical blebs or bullae when predicting recurrences (17).

In conclusion, studying SP recurrences remains difficult because many factors are involved. Choosing the initial treatment procedure should take into account the recurrence risks, but no randomized data on a homogeneous SP population are as yet available to favour a particular technique. At present, the best way to optimize SP management is to apply the published guidelines (3).

Acknowledgements

The authors gratefully acknowledge Mrs A. Martin and M. R. Cooke for their contribution in translation of the manuscript. This study was supported by grants from Institut Pneumologique d'Aquitaine.

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